THE EFFECT OF THE EUROPEAN WILD BOAR (SUS SCROFA) ON THE WOODY VEGETATION OF GRAY BEECH FOREST IN THE GREAT SMOKY MOUNTAINS

RESEARCH/RESOURCES MANAGEMENT REPORT No. 18

U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SOUTHEAST REGION

UPLANDS FIELD RESEARCH LABORATORY
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THE EFFECT OF THE EUROPEAN WILD BOAR (*SUS SCROFA*) ON THE WOODY VEGETATION OF GRAY BEACH FOREST IN THE GREAT SMOKY MOUNTAINS

Research/Resources Management Report No. 18

October 1977

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Huff, Mark H. 1977. The Effect of the European Wild Boar (_Sus_ _scrofa_) on the Woody Vegetation of Gray Beech Forest in the Great Smoky Mountains. U.S. Department of the Interior, National Park Service, NPS-SER Research/ Resources Management Report No. 18. 34 pp., with 63 pages of appendices.

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ABSTRACT

The European wild boar (*Sus scrofa* L.) was introduced into the mountains of North Carolina in 1912 and has since spread into the Great Smoky Mountains National Park. Omnivorous feeding and rooting disturbance by this exotic species is a management problem in the park. The Gray Beech Forest is intensively used by the wild boar. Beech (*Fagus grandifolia*) communities occupied by wild boar displayed a reduction in total understory-reproductive plant cover. However, these disturbed areas have a slight increase in total woody plant cover. Vegetative sprouts of beech in disturbed areas were 4 to 45 times more numerous than sprouts in undisturbed areas. Beech and blackberry (*Rubus canadensis*) disturbed by hog rooting had high populations in the reproductive stratum.

ACKNOWLEDGEMENTS

I am indebted to a great number of persons who have made the completion of this study possible. Dr. Susan P. Bratton, Francis J. Singer, and Mark E. Harmon from Uplands Field Research Laboratory have aided in project guidance and field assistance. The Great Smoky Mountains Natural History Association and Duke University deserve my special gratitude for financial assistance. Dr. Roger F. Anderson and Dr. William J. Stambaugh from Duke University School of Forestry and Environmental Studies, Dr. Henry Wilbur, Duke University Department of Zoology, and Dr. Ray Herrmann, Chief, Natural Science and Research Division, National Park Service, Southeast Regional Office gave advice and editorial assistance. I am grateful to Superintendent Boyd Evison and his staff at the Great Smoky Mountains National Park for moral support of a research program. A very special thanks to Sue Seegers and Nicki Macfarland for their patience and typing assistance.

INTRODUCTION

The southern Appalachian highlands harbor a considerable number of endemic and disjunct plant species that date back to tertiary forests (Braun 1950). Great Smoky Mountains National Park (GRSM) is a sanctuary within this region for a richly diversified flora and fauna.

In 1912, the European wild boar (Sus scrofa L.) was introduced into the mountains of North Carolina (Stegeman 1938). The spread and history of the wild boar in North Carolina, Tennessee, and Great Smoky Mountains National Park was reviewed by Bratton (1975). Since the late 1940's, this exotic animal has been extending its range eastward across the park. In the park the hog has created complex management problems not easily resolved. The wild boar disturb wild flowers, tree roots, and seedlings; compete with other animal populations; and cause soil erosion in hog rooted and wallowed habitats (Bratton 1974b). The research presented here investigates one of the management problems created by this exotic species, the wild boar's effect on the reproduction and distribution of woody species in Gray Beech Forest.

Feeding and Rooting Activity of the European Wild Boar in Beech Forest

European wild boar are omnivorous and are habitat generalists. Relatively little is known about the food habits of this invading species in the southern Appalachians. Henry and Conley (1972) studied their food habits in an oak-hickory woodland in Tennessee. A fall mast crop comprised a majority of the food consumed, with 89.4 percent and 6.4 percent representing volume of plant matter and animal food respectively. Forest dominated by sugar maple, beech, and yellow birch represented only 3.5 percent of their study area.

The availability of mast in the Gray Beech Forest of the Great Smoky Mountains National Park is unknown. Beechnuts ripen between September and November, however, the beech forest habitat was usually occupied by large boar populations during the spring and summer months. Beechnuts are probably not an important potential food source. Neither Russell (1953) nor I in the present study found a single seedling of beech in the high-elevation forests. Root suckers are the major form of reproduction. Russell found that seeds were produced in the gaps by large trees in 1948. The viability of reproduction by gray beechnuts of Great Smoky Mountains National Park has never been investigated.

The large starchy fruit of yellow buckeye ripens in September and germinates in the early spring after the seeds have wintered on the ground (Fowells 1965). Fowells also stated that no further information is available on the number of seeds produced by individual trees, the conditions favoring seed production, and the frequency of seed years. Yellow buckeye represents a potential food source for hogs but effects of the poisonous glucoside, aesculin, in the fruit have not been investigated. Conley et al., (1972) have observed the food utilized by the hogs in the Tellico management area of Tennessee. Bratton (1974a) composed a general and species list of Eurasian plants eaten by the wild boars that are also common to the Great Smoky Mountains National Park. Both researchers have indicated that many woody species are potential foods for the wild boar.

During spring and summer the beech forests have a large quantity and diversity of herbaceous flora from which the hogs can feed continuously in small areas. As the summer wanes, the amount of food becomes scarce and the hogs continue to root the same areas, resulting in the tilled garden appearance of the soils in parts of the Gray Beech Forest.

Study Area

Gray Beech Forest located on higher elevation ridges of the Great Smoky Mountains National Park was chosen as the sampling area for determining effects of the wild boar's invasion into the park. The gray beech community, dominated by *Fagus grandifolia*, has been well described by various authors (Cain 1931; Russell 1953; Whittaker 1956; Crandell 1958), but the structure of the plant community has been rapidly changing since the boar's invasion (Bratton 1974a, 1975). These mesic beech forests are one of the most intensely hog-rooted habitats in Great Smoky Mountains National Park. Bratton (1974) reported that herbaceous cover is drastically reduced in hog-disturbed sites when compared to undisturbed sites.

In the summer of 1976, 10-meter by 10-meter plots were located in both undisturbed and hog-rooted beech forests. These sites were in areas similar to those sampled by Bratton (1975) in the summer of 1973. A total of 115 plots were established, of which 63 were in hog-rooted areas while the remaining 52 were in undisturbed stands (Fig. 1). The first 63 plots were grouped into five major locales: Jenkins Knob to the Narrows (including Double Springs), Silers Bald, Derrick Knob, Cold Spring Knob and Hemlock Knob, and Spence Field to Little Bald. The undisturbed plots were in four major locales: Newfound Gap, Indian Gap, Mesa Knob, and Pauls Gap/Beech Gap (Table 1).

Russell (1953) has described the beech gaps as small stands or deciduous "islands" in the forest. All the undisturbed plots from this study were from gaps having this characteristic "island" appearance. All hog-disturbed plots were located in the continuous expanse of crestline beech forest west of Double Springs (Jenkins Knob). It is impossible to verify that the disturbed and undisturbed areas were identical in vegetative character prior to hog invasion. The vegetative composition of each sample location is a unique occurrence. However, prior to major invasion these two areas were largely similar (Russell 1953; Whittaker 1956) and minor inherent differences in the stands did not obscure the changes caused by hogs.

The low elevation beech forests of Cold Spring Knob and Hemlock Knob, Derrick Knob, and Spence Field to Little Bald were comparatively similar to Newfound Gap, Pauls Gap, and Beech Gap (Tables 1-4). The high elevation beech forests near Silers Bald and Jenkins Knob to the Narrows were similar to Indian Gap and Mesa Knob.

Mesa Knob was the most unusual stand due to its high elevation and the intergradation with the spruce-fir forest. As one moves eastward, Mesa Knob is the last of the crestline beech forests (Fig. 1) until the far eastern boundaries of the park are encountered. Pauls Gap and Beech Gap in the northeast section of the park were the only plots not on the crest of the Great Smoky Mountains. Nevertheless, they are rich mesic beech gaps under the influence of the Upper Cove Forest.

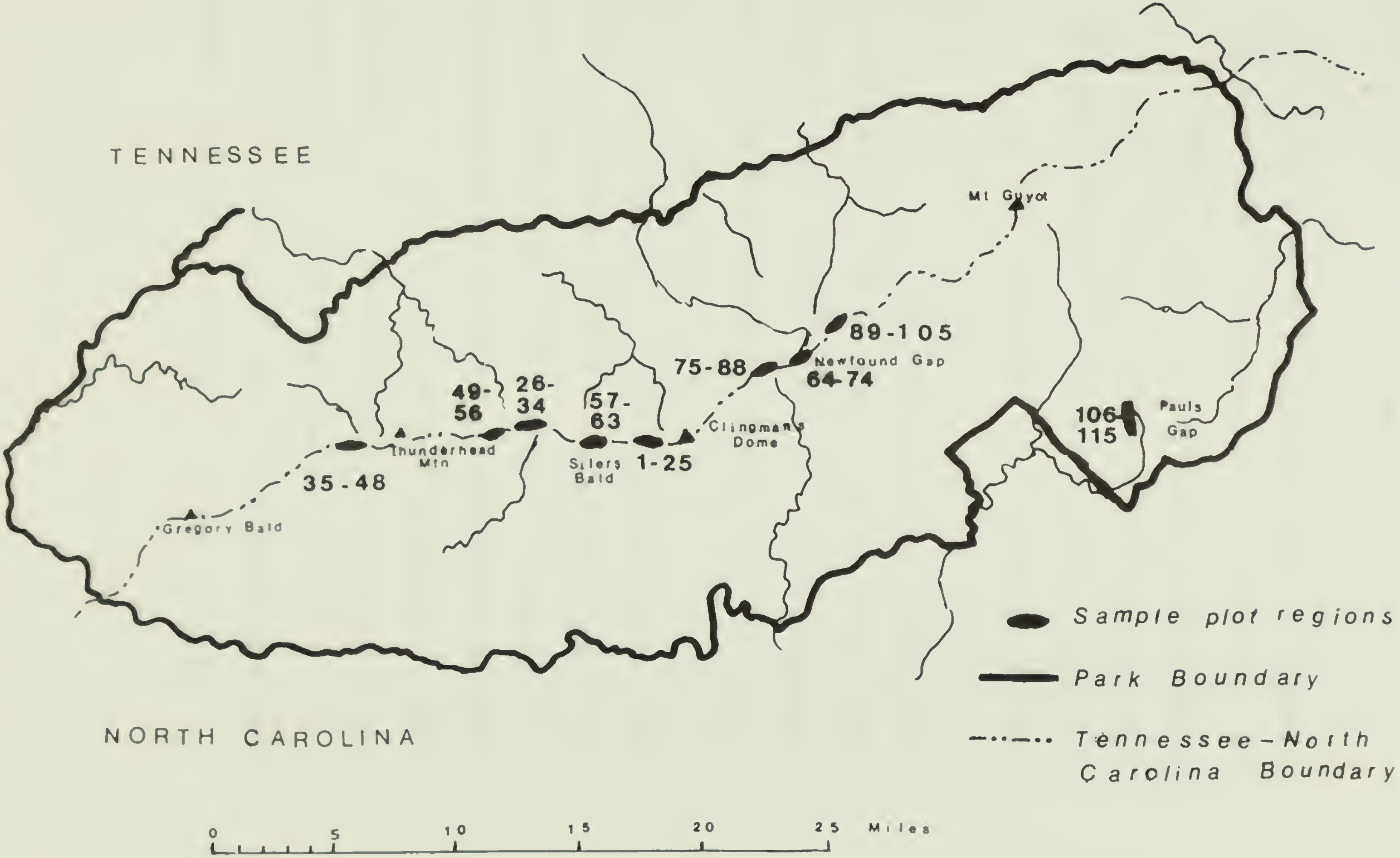
Methods

Disturbed and undisturbed sites were subjectively chosen. Each individual plot within a site was located using random distances of 10 to 40 meters and random compass directions. In some locations where random plots may have caused excessive overlap, the first plot was chosen at random, and random non-overlapping adjacent plots were sampled. The plots were free from recent fires, logging, or other major disturbances and at least 8 meters away from any trail. Each plot was 100 square meters, with a nested 25-square meter sub-plot in the northeast corner. The diameter at breast height (dbh) of all species greater than 2.5 centimeters were measured in the entire plot. The 25-square meter plot was used to evaluate all woody species with a dbh less than 2.54 centimeters. These individuals were separated into two size classes. Individuals that were greater than 40 centimeters in height were evaluated in four 6.25-square meter plots (understory (U) plots). Individuals less than or equal to 40 centimeters in height were evaluated from 25-square meter plots (reproductive (R) plots). Each individual within its respective species was tallied. (Multiple stems originating from one apical region were observed as one stem.) The number of stems per plot for each U and R plot

Figure 1. The location of beech forest plots 1 to 115 in the Great Smoky Mountains National Park.

1 - 25	Jenkins Knob to the Narrows (Double Springs)
26 - 34	Cold Spring Knob and Hemlock Knob
35 - 48	Spence Field to Little Bald
49 - 56	Derrick Knob
57 - 63	Silers Bald
64 - 74	Newfound Gap
75 - 88	Indian Gap
89 - 105	Mesa Knob
106 - 115	Pauls Gap and Beech Gap

GREAT SMOKY MOUNTAINS



was a composite value originating from the total of all stems within each 25-square meter plot (i,e., 8 stems per U plot or 8 stems per 25 square meters for a U plot). Each size class plot (1 square meter or 6.25 square meters) was given a percentage cover value for the woody species in the plot. A total of 252 disturbed and 208 undisturbed plots were measured to evaluate the young understory, while 1,575 disturbed and 1,300 undisturbed plots measured the reproductive cover.

The taxonomic and nomenclature employed in this paper are after Radford et al. (1968). All plots were located on USGS 7.5-minute topographic maps. Elevation, aspect, and field notes (i. e., grazing or other disturbances) were recorded for each plot.

Basal area and relative dominance was computed on a Monroe programmable calculator. A digital computer was employed for linear regression of beech plots. The G-statistical method (numerically similar to chi-square) illustrated the 2 x 2 test of independence in beech reproduction. The only fixed variable was the sample size. Since $f \ln f$ tables were available, this statistical test was computationally simpler than chi-square. The sample size was less than 200, so Yates' correction was used to adjust the observed frequencies by 0.5 (Sokal and Rohlf 1969).

Table 1. The elevation range and number of plots by location on boar-disturbed and undisturbed sites in Great Smoky Mountains National Park

Location	Abbreviation	Elevation Range (m)	Disturbed (D) or Undisturbed (UD)	No. of plots
Cold Spring Knob and Hemlock Knob	CKHK	1450-1560	D	9
Derrick Knob	DK	1460-1490	D	8
Spence Field to Little Bald	SFLB	1490-1530	D	14
Silers Bald	SB	1615-1645	D	7
Jenkins Knob to the Narrows	JKN	1660-1685	D	25
Newfound Gap	NG	1510-1585	UD	11
Pauls Gap and Beech Gap	PGBG	1545-1560	UD	10
Indian Gap	IG	1640-1660	UD	14
Mesa Knob	MK	1680-1725	UD	17

RESULTS

Overstory Vegetation

The high-elevation Gray Beech Forest is dominated by American beech (Fagus grandifolia). Bratton (1975) indicated that yellow buckeye (Aesculus octandra) was the second most frequent tree, while yellow birch (Betula lutea) was third most frequent. In this study a total of 22 aborescent species were recorded; 17 were found in the overstory. In all locations, beech was the most important tree species (Tables 1, 2, 5, and 6 in the Appendix). The relative dominance of beech in disturbed areas varied from 31.1 percent at Cold Spring Knob to 81.6 percent at Silers Bald. The relative dominance of beech in undisturbed gap plots remains close to 65 percent.

Yellow birch frequently occurred on north-facing slopes and in the regions between spruce-fir forests. Many undisturbed sites are "island" beech gaps located among extensive spruce-fir. In this topographic position the proportion of yellow birch was infrequent at the lower elevations and common in the high-elevation plots of Indian Gap and Mesa Knob. Yellow birch was an unimportant species in high-elevation beech forests west of Clingmans Dome (Figure 1). The crestline plots at lower elevations, such as Spence Field to Little Bald and Derrick Knob, indicated that yellow birch was a major community associate.

Bratton (1975) describes yellow buckeye as a common associate when Gray Beech Forest grades into Upper Cove Forest. Yellow buckeye was an important component for all plots west of Clingmans Dome and occupied 12 percent to 22 percent relative basal area for all disturbed plots sampled (Table 2). In the high-elevation gaps, yellow buckeye populations disappeared, with the exception of a few individuals on the south slopes of Newfound Gap and Indian Gap. Yellow buckeye increased its dominance at the edge of the moist Upper Cove Forest at Pauls Gap and Beech Gap. Sugar maple (_Acer saccharum_) was a common species in the moist low-elevation beech forests. Derrick Knob, Cold Spring Knob, and Hemlock Knob were strongly influenced by this Upper Cove Forest species, yet it was almost absent from Spence Field to Little Bald. Red spruce (_Picea rubens_) and Fraser fir (_Abies fraseri_) were most common in the beech forests when the forests were surrounded by spruce-fir at high elevations.

The average total basal area for all species per plot was lowest at higher elevations while the lower mesic forests of Newfound Gap displayed the largest basal area per plot (Table 2). A trend in all sites sampled except Silers Bald indicated that the average total basal area per plot decreased as the elevation of the sample plots

Table 2. The relative proportion (percent) of basal area for woody species greater than 2.5 centimeters diameter at breast height in boar-disturbed and undisturbed areas.

	LOCATION*								
	DISTURBED					UNDISTURBED			
	CKHK	DK	SFLB	SB	JKN	NG	PGBG	IG	MK
Species	%	%	%	%	%	%	%	%	%
Abies fraseri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	4.4
Acer pensylvanicum	0.03	1.8	0.0	0.0	0.0	1.3	0.2	0.1	0.0
Acer saccharum	31.2	16.4	0.5	1.6	0.5	4.5	7.1	0.0	0.0
Acer spicatum	0.0	0.0	0.2	0.3	0.0	0.4	0.0	1.3	0.6
Aesculus octandra	17.8	22.4	14.1	11.9	20.7	5.1	20.8	9.0	0.0
Amelanchier aborea var. *laevis*	0.0	0.3	0.02	0.0	0.1	0.8	0.0	0.0	0.0
Betula lenta	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Betula lutea	10.3	15.9	23.7	0.0	1.3	12.1	3.3	21.9	32.9
Cornus alternifolia	0.1	0.0	0.1	0.0	0.0	0.0	0.03	0.0	0.1
Crataegus sp.	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Fagus grandifolia	36.1	43.4	55.1	81.6	71.7	63.0	65.4	63.9	45.9
Halesia carolina	4.3	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0
Picea rubrens	0.0	0.0	0.0	4.7	3.7	6.6	0.0	3.6	13.1
Prunus pensylvanica	0.0	0.0	0.0	0.0	0.1	0.0	2.9	0.0	0.9
Prunus serotina	0.0	0.0	1.7	0.0	1.8	0.0	0.0	0.0	0.0
Quercus rubra	0.04	0.0	4.3	0.0	0.0	0.0	0.2	0.0	0.0
Sorbus americana	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	2.2
Viburnum alnifolium	0.0	0.0	0.0	0.0	0.0	0.02	0.0	0.03	0.0

*See Table 1

increased. Field sampling at Silers Bald had to be terminated after seven plots due to continuous encounters with black bears. It is probable that the large basal area difference for the Silers Bald area was due to inadequate sample size for estimating the overstory vegetation.

Understory Vegetation

Composition

Beech and blackberry were dominant in the understory of undamaged areas. Beech comprised 40 percent of the stems at Pauls Gap and Beech Gap but blackberry dominated the areas at higher elevations, accounting for 50 percent or more of the woody stems. Hobble-bush (*Virburnum alnifolium*) occurred sporadically, with large populations at Newfound Gap and Indian Gap (Table 3).

The hog-disturbed understory plots were also dominated by beech and blackberry, but the distribution patterns were different from those in the undisturbed areas. Beech represented a majority of the understory stems in the higher elevation plots at Silers Bald and the area from Jenkins Knob to the Narrows. Beech was less abundant at lower elevations. The distribution of blackberry was irregular. Blackberry was most common from Spence Field and Little Bald, but did not occur at Silers Bald or Derrick Knob. Sugar maple was a significant understory component at Derrick Knob, Cold Spring Knob,

Table 3. The proportion (percent) of woody species in the understory (U-plots) in boar-disturbed and undisturbed areas.

	LOCATION*								
	DISTURBED					UNDISTURBED			
Species	CKHK %	DK %	SFLB %	SB %	JKN %	NG %	PGBG %	IG %	MK %
Abies fraseri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.9
Acer pensylvanicum	0.0	1.3	0.0	0.0	0.0	0.8	0.0	0.6	0.0
Acer saccharum	22.1	28.9	0.0	0.0	0.0	0.0	17.6	0.0	0.0
Acer spicatum	0.0	0.0	0.0	5.6	0.0	4.2	0.0	1.9	1.7
Aesculus octandra	1.6	13.2	2.1	7.4	4.8	1.1	3.6	0.0	0.0
Amelanchier aborea var. *laevis*	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Betula lutea	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.0
Cornus alternifolia	0.5	0.0	0.8	0.0	0.0	0.0	2.4	0.0	0.9
Crataegus sp.	0.5	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Fagus grandifolia	17.9	55.3	32.9	81.5	83.8	22.3	39.9	10.9	26.0
Halesia carolina	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0
Picea rubrens	0.0	0.0	0.0	0.0	1.0	0.3	0.0	1.3	0.0
Prunus pensylvanica	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0
Quercus rubra	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rubus canadensis	57.4	0.0	62.9	0.0	10.5	24.3	31.5	49.4	62.1
Sorbus americana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.4
Vaccinium constablaei	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.4
Vaccinium erythrocarpun	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	4.6
Virbunum alnifolium	0.0	0.0	0.0	5.6	0.0	40.6	1.8	33.4	3.0
Virburnum cassinoides	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0

*See Table 1

and Hemlock Knob. Yellow buckeye was distributed throughout the hog-disturbed areas, but represented less than 10 percent of the stems at the sites sampled.

In the woody reproductive (seedling, small sapling) size class, blackberry was a major component in undamaged gaps (Table 4). Beech stems varied from 7 to 11 percent of the stems and were widely scattered among the thick herbs. At the disturbed sites, reproductive class beech was far more important, accounting for 80 percent to 90 percent of the stems at some locations such as Derrick Knob and Silers Bald. Blackberry was patchy in its occurrence, with none at Derrick Knob and large populations at Cold Spring Knob and Hemlock Knob. Beech and blackberry were equally common from Spence Field to Little Bald. The seedling populations of sugar maple and buckeye were insignificant at the hog-disturbed sites.

Total estimates of plant ground cover were made for determining trends in both disturbed and undisturbed areas. The plant cover in the undisturbed areas ranged from 60 percent at Pauls Gap and Beech Gap to almost 100 percent at Mesa Knob. The percent cover for the disturbed areas ranged from 10 percent at Jenkins Knob, and up to 40 percent at Hemlock Knob, the latter a relatively lightly rooted site. At the time of this study, Indian Gap had an understory cover above 80 percent but had suffered hog rooting for the first

Table 4. The proportion (percent) of woody species reproduction (R-plots) in boar-disturbed and undisturbed areas.

	LOCATION*								
	DISTURBED					UNDISTURBED			
	CKHK	DK	SPLB	SB	JKN	NG	PGBG	IG	MK
Species	%	%	%	%	%	%	%	%	%
Abies fraseri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	18.4
Acer pensylvanicum	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.7	0.0
Acer saccharum	2.2	2.7	0.2	0.0	0.0	1.5	28.3	0.0	0.0
Acer spicatum	0.0	0.0	0.0	0.4	0.0	3.6	0.0	0.4	0.0
Aesculus octandra	1.4	5.4	1.1	1.2	0.3	1.0	4.1	0.0	0.0
Amelanchier aborea var. *laevis*	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Cornus alternifolia	0.0	0.0	0.4	0.0	0.0	0.0	0.7	0.8	0.0
Crataegus sp.	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Fagus grandifolia	18.8	91.8	48.8	91.2	82.0	8.2	11.0	8.5	7.1
Picea rubrens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Prunus pensylvanica	0.0	0.0	0.4	0.0	0.0	1.0	2.1	0.4	0.0
Prunus serotina	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0
Quercus rubra	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
Rubus canadensis	76.1	0.0	49.0	6.0	16.2	32.3	46.9	43.6	66.3
Sorbis americana	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
Vaccinium constablaei	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Vaccinium erythrocarpum	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0
Viburnum alnifolium	1.1	0.0	0.0	1.2	0.0	45.6	4.8	43.6	5.1
Viburnum cassinoides	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0

*See Table 1

time during that growing season. Rooting of this area was still of minor importance.

Russell (1953) and Schofield (1960) found the plant cover in the Double Springs-Jenkins Knob area to be similar to that of other gaps. Wolfe (1967) described the herbaceous cover as almost 100 percent. Bratton (1975) reported the herbaceous cover in 1973 had declined to 8 percent to 10 percent after the hog invasion. Samples collected for this study in 1976 indicate that the cover is remaining at approximately the 10 percent level. A majority of the lower strata cover is beech and blackberry.

Ferns were an important plant cover component of undisturbed sites but were scarce in the disturbed areas. Bratton (1974a) lists two ferns as being eaten by wild boar in Eurasia but notes that ferns in the hog-rooted beech gaps appear to be killed incidentally, uprooted, and desiccated rather than being eaten. Observations made in the recently invaded Indian Gap area indicate that Lady fern (Athyrium felix-femina) was rarely chosen as a primary food and neither leaves nor roots were consumed. The utilization of various fern species as food items is probably related to the amount of starch in the rhizome and the availability of other food sources.

Table 5. The average percent cover and average number of stems per plot of woody species in understory (U) plots and reproduction (R) plots on hog-disturbed and undisturbed areas.

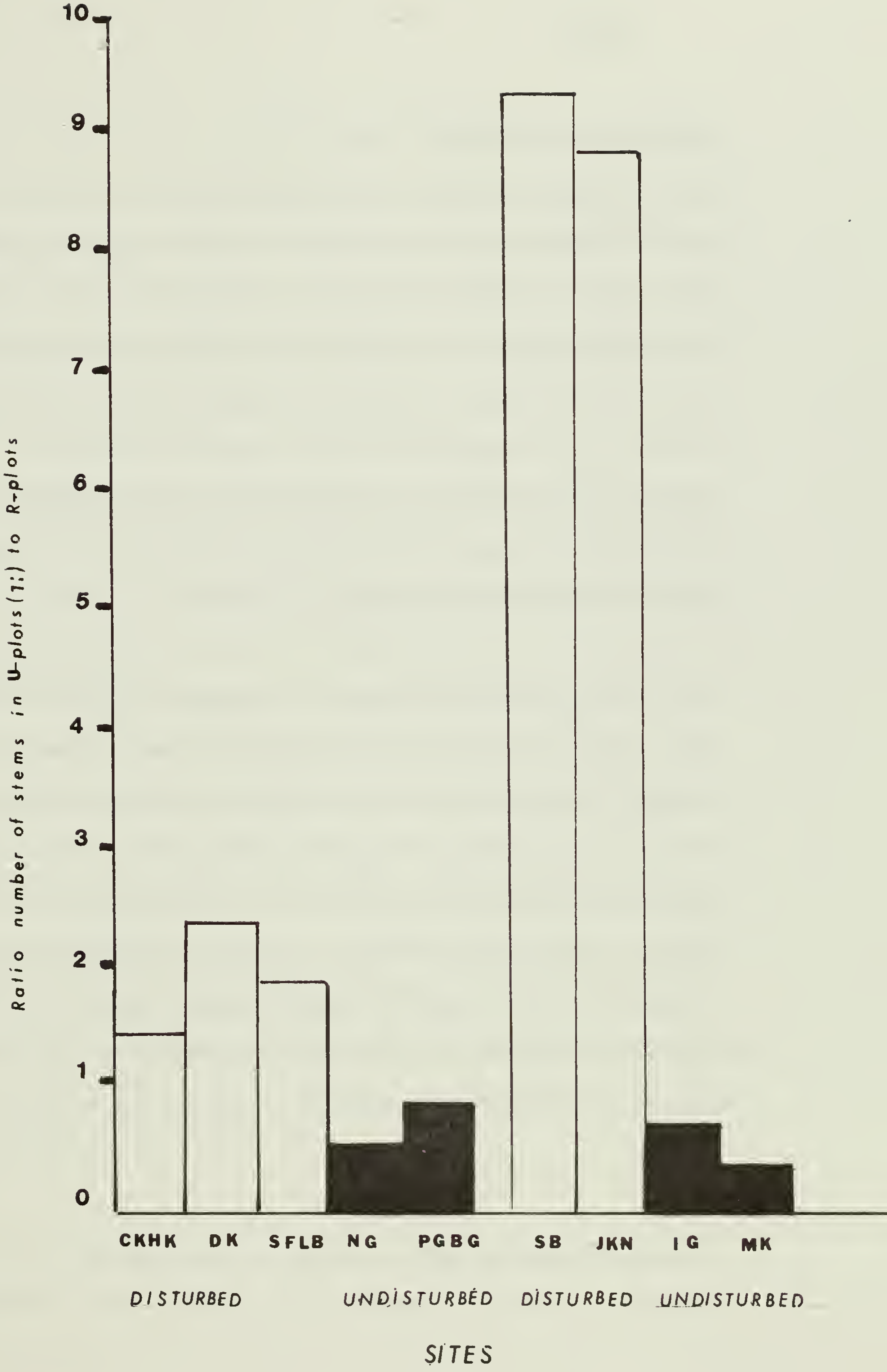
	U-Plots				R-Plots			
Location*	Avg. % cover	Avg. No. stems/plot	% Rel. dom. stems Fagr	% Rel. dom. stems Ruca	Avg. % cover	Avg. No. stems/plot	% Rel. dom. stems Fagr	% Rel. dom. stems Ruca
Disturbed								
Cold Spring Knob and Hemlock Knob	22.8	21.1	17.9	57.4	7.0	30.6	18.8	76.1
Derrick Knob	11.0	9.5	55.3	0.0	4.3	23.0	91.8	0.0
Spence Field to Little Bald	17.7	17.1	32.9	62.9	7.9	33.6	48.4	49.0
Silers Bald	21.7	7.7	81.5	0.0	8.1	35.9	91.2	6.0
Jenkins Knob to the Narrows	11.2	4.2	83.8	10.5	5.1	37.1	82.0	16.2
Undisturbed								
Newfound Gap	37.4	32.4	22.1	24.3	4.2	17.7	8.2	32.3
Pauls Gap and Beech Gap	25.6	16.8	39.9	31.5	4.0	14.5	11.0	46.9
Indian Gap	25.8	22.2	10.9	49.8	4.5	16.9	8.5	43.6
Mesa Knob	11.7	13.8	26.0	62.1	1.8	5.8	7.1	66.3

*See Figure 1 and Table 1.

Figure 2. The ratio of the total number of woody stems in understory plots to reproduction (R) plots for boar-disturbed and undisturbed areas.

NOTE: For location, see Table 1.

Figure 2


Ratio number of stems in U-plots (1:) to R-plots
10
9
8
7
6
5
4
3
2
1
0
CKHK
DK
SFLB
NG
PGBG
SB
JKN
IG
MK
DISTURBED
UNDISTURBED
DISTURBED
UNDISTURBED
SITES

Size Class Composition

The disturbed plots had a much larger ratio of reproductive size stems to understory size stems of all species than the undisturbed plots (Fig. 2). This phenomenon was related to several factors. The average number of understory size stems was far less in disturbed plots than in undisturbed ones, while the average number of stems in the reproductive size class was substantially greater in the disturbed plots. The reproductive stems were present in large numbers in the disturbed plots, but most have failed to grow beyond 40 centimeters in height.

Beech root sprouts were primarily responsible for the increase in the reproductive size class in disturbed areas. Although the average beech stem density for undisturbed understory plots was 4.6 stems per plot and 4.5 stems per plot for disturbed plots, the number of reproductive size stems was four to 45 times greater in the disturbed sites (Table 6). This difference is probably not due to canopy composition, since the average basal of beech in the disturbed plots was 21.5 square meters per hectare while that of the undisturbed plots was 21.8 square meters per hectare.

It should be noted that the amount of root sprouting was variable among disturbed plots. The area from Spence Field to Little Bald, with the longest history of disturbance by wild boar of the study sites, had a high average number of reproductive size stems per plot. The greatest number of root sprouts, however, was found in the more recently invaded higher elevation stands near Silers Bald. This increase in the number of root sprouts is consistent with an increase in the basal area of beech.

Linear regressions show the relationship between the basal area of beech per plot (independent variable) and the number of beech stems per plot (dependent variable) for both the reproductive size stems from disturbed plots and the understory size stems from undisturbed plots (Tables 6, 7, and 8). As basal area of beech increases, so does the root-sprouting response to hog-rooting activities. The number of reproductive size stems in undisturbed plots, however, did not increase with basal area. The opposite seems to be true for the understory size class where only the undisturbed plots provided a significant regression. These statistical relationships indicate that hog rooting is a significant regression. These statistical relationships indicate that hog rooting is a significant disturbance to the reproduction of beech and causes serious alterations within the understory.

The presence or absence of beech in different size classes for disturbed and undisturbed plots is summarized in Tables 9 and 10. The observed G-statistic for beech in the reproductive size plots was

Table 6. The proportion of overstory basal area (square meters per hectare), average number of stems per plot, and relative frequency of *Fagus grandifolia* in disturbed and undisturbed understory plots and reproduction plots.

Location*	Disturbed plots				Reproduction plots	
	No. of plots	Overstory basal area m^2/ha	Avg. no. of stems/ plot	Rel. % frequency/ site	Avg. no. of stems/ plot	Rel. % frequency/ site
Disturbed						
Cold Spring Knob and Hemlock Knob	9	14.8	3.8	100.0	5.8	77.8
Derrick Knob	8	16.0	5.3	100.0	20.6	75.0
Spence Field to Little Bald	14	21.2	5.6	85.7	16.3	100.0
Silers Bald	7	34.6	6.3	85.7	65.4	100.0
Jenkins Knob to the Narrows	25	22.1	3.5	92.0	30.4	100.0
Undisturbed						
Newfound Gap	11	29.3	7.2	90.9	1.5	45.5
Pauls Gap and Beech Gap	10	24.8	6.7	90.0	1.6	70.0
Indian Gap	14	21.2	2.4	71.4	1.4	42.9
Mesa Knob	17	15.6	3.6	88.2	0.4	29.4

*See Figure 1 and Table 1.

Table 7. Regression statistics of basal area per plot versus stems per plot of *Fagus grandifolia* for understory (U) and reproduction (R) plots in disturbed and undisturbed areas.

	U-plots in disturbed region			
Source of variation	df	SS	F	Prob. F > .05
Explained model	1	39.77	2.45	Not significant
Total	56	931.93		

	R-plots in disturbed region			
Source of variation	df	SS	F	Prob. F > .05
Explained model	1	4,125.15	8.36	0.005
Total	58	32,239.56		

	U-plots in undisturbed region			
Source of variation	df	SS	F	Prob. F > .05
Explained model	1	85.89	4.81	0.034
Total	42	818.65		

	R-plots in undisturbed region			
Source of variation	df	SS	F	Prob. F > .05
Explained model	1	2.59	0.95	Not significant
Total	22	59.65		

Table 8. Summary of regression significance (+) of basal area per plot versus stems per plot of *Fagus grandifolia* for total U- and R-plots in disturbed and undisturbed regions.

U-plots	R-plots
+	-
-	+

Table 9. 2 x 2 Test of independence of *Fagus grandifolia* in reproductive (R) plots using the G-statistic[1]

Stem class	Disturbed	Undisturbed	Total
With stems	58.5	23.5	82
Without stems	4.5	27.5	31
Totals	63	51	114

Computed G-statistic	Chi-square
$G_{adj} = .32.536$	$\chi^2_{.05\,[1]} = 3.841$

Table 10. 2 x 2 Test of independence of *Fagus grandifolia* in understory (U) plots using the G-statistic[1]

Stem class	Disturbed	Undisturbed	Total
With stems	56.5	45.5	102
Without stems	6.5	5.5	12
Totals	63	51	114

Computed G-statistic	Chi-square
$G_{adj} = .005$	$\chi^2_{.05\,[1]} = 3.841$

---

[1] Yates correction for sample sizes less than 200 was observed (Sokal and Rohlf 1969).

much greater than the chi-square value for one degree of freedom. The null hypothesis that the presence or absence of beech reproduction was independent of hog rooting was therefore rejected. In the case of the understory size class, however, the null hypothesis was accepted.

The occurrence of yellow buckeye was too infrequent for statistical tests, but these data can be compared to those of Russell (1953). Russell, sampling over a shorter vertical interval at Jenkins Knob, found 7 stems per 5 square meters, while the 1976 plots from the same area had 5 stems per 5 square meters. This difference is not great enough to be of significance.

Sugar maple was also too uncommon to apply statistical tests but the disturbed vegetation of Derrick Knob, Cold Spring Knob, and Hemlock Knob can be compared to undisturbed populations of Pauls Gap and Beech Gap. The density of sugar maple in the reproductive size class was 4.5 to 6.5 times greater in undisturbed plots than in the disturbed plots. Note, however, that the undisturbed plots had 1.2 times more reproductive stems than understory stems per plot.

The total average density of undisturbed understory size stems of blackberry was 8.3 stems per plot. This was 1.9 times greater than disturbed average of 4.4 stems per plot. There was a definite reduction in the tall (.5 to 1 meter) arching branches of blackberry, which is characteristic of mature plants. In the case of reproductive size stems, however, there were 1.7 times more in the hog-disturbed areas (9.9 stems per plot) than encountered in the undisturbed plots (5.8 stems per plot). The total number of stems per plot thus was almost the same for the two types of areas (14.3 stems per plot for disturbed sites and 14.1 stems per plot for undisturbed) but the size distribution of the stems was quite different.

DISCUSSION

Bratton (1974a, 1975) documents a reduction in herbaceous cover, reductions in the populations of individual herb species, and changes in herb community structure, due to the invasion of wild boar into Gray Beech Forest. Even though the diversity of arborescent species is relatively low in Gray Beech Forest, this study shows that hog-rooting activity is responsible for an increase in the number of reproductive stems of beech, a slight increase in total reproductive cover, and an increase in total reproductive stems.

Since only the hog-disturbed areas contained large numbers of root sprouts, it was evident that the feeding behavior of the wild boar was responsible for these changes. The actual stimulus for the production of the sprouts is unknown, however. Present theory states that the vegetative reproductive response is often provoked by injury to the tree, but beech suckers also occur in undisturbed areas. Either the exposure or injury of the roots by hogs or the tilling of the soil may stimulate this increase in reproductive beech stems. Destruction of the dense herbaceous cover and increased solar radiation to the mineral soil may also be important.

The amount of reproduction seems to be related to elevation and the basal area of canopy-sized beech (these two variables are not independent). The lowest elevation disturbed plots showed a ninefold increase in reproductive size beech stems over the most similar disturbed areas, while the high elevation disturbed plots, like those of Silers Bald, showed a forty-fivefold increase over the most undisturbed areas, such as Indian Gap.

When Russell (1953) sampled the vegetation near Double Springs Gap, he placed all aborescent species into one-inch dbh (diameter at breast height) classes. All species less than one inch dbh and greater than 6 feet in height were put in one class, in which 96 stems per 500 square meters at Double Springs were counted. The understory plots for this study measured all stems greater than 40 centimeters in height and less than 1 inch dbh. Although this study used a size class that contained 1.4 meters more vertical distance in the stratum and, therefore, should have included more individuals than Russell's, the 1976 plots had 70 stems per 500 square meters--26 stems per 500 square meters fewer than the figure cited by Russell. This indicates a decrease in understory size stems, which implies that over a long time period the hogs may disturb the natural size distribution of overstory species. Hog invasion is too recent for verification of long-term successional trends, since edaphic and climatic factors may also be involved, but the potential for alteration exists.

A long-term permanent plot is necessary to answer important questions such as:

1. How well will the reproductive size beech stem survive?

2. What will be the hogs' long-term effects on canopy composition?

3. If wild boar populations are reduced through control efforts or natural events, how will the small beech stems interact with a recovering herbaceous community?

The data have indicated that the continual disturbance by hogs is holding blackberry (*Rubus canadensis*) in the lower vertical stratum near the ground. The leaves, roots, and fruits have been cited as boar food in Eurasian studies (Bratton 1974a). The evidence for this in the Great Smoky Mountains National Park has been sporadic. Although the tender new shoots of *R. canadensis* have occasionally been grazed in sample plots, remnant abundance of *R. canadensis* indicated that it is not preferred food for the wild boar. Mark Harmon, a park technician studying hog food habits, has observed wild boar feeding directly on the leaves and stems of *Rubus canadensis* is in the Great Smoky Mountains National Park.

This species of blackberry does not fruit under an overstory canopy; therefore reproduction in a forested situation is vegetative. *R. canadensis* did flower along trails and fringes of grassy balds where there was sufficient radiant energy to stimulate sexual reproductive structures. The fruits are eaten by black bears and apparently by wild boar. These species are a potential source for immigration of seeds by fecal excretions. The actual rooting of blackberry populations was highly variable. Shaffer (1977) indicated that both woodland and field patches of blackberry at the Spence Field area were rooted to varying degrees. It is difficult to make definite conclusions concerning the future populations of _R. canadensis_ in areas rooted by the European wild boar. The actual frequency/site showed that blackberry occurred irregularly within sample plots. Apparently, this clumped distribution was a result of reproduction from root meristem in the surface horizon. Other variables such as intensity of rooting, the vegetative response to disturbances, the immigration and success of seeds, and the light conditions defining the reproduction of this species are needed to furthur investigate the relationships between the wild boar and _R. canadensis_ populations.

The fate of the less common species, such as alternate-leaved dogwood (_Cornus alternifolia_), is difficult to evaluate. Although there is evidence that yellow buckeye, sugar maple, and shrubs are being disturbed, an assessment of the eventual impact of the wild boar on their distributions and on their gene pools will require careful work with permanent plots.

SUMMARY AND CONCLUSION

The hog invasion into the Gray Beech Forest has significantly altered the structure and composition of arborescent species in the Great Smoky Mountains National Park. The effects of the boar as observed in disturbed and undisturbed locations were:

1. The disturbed areas had a substantial reduction in total plant cover, including both herbaceous and woody species.

2. The disturbed plots had a 3 to 26 percent reduction in woody understory cover in lower elevation areas.

3. The undisturbed plots had a slight increase in total woody cover.

4. Hog rooting stimulated a vegetative reproductive response in *F. grandifolia*. Root suckers accounted for the tremendous increase in beech reproductive cover, which was 4 to 44 times greater than in undisturbed plots.

5. The increased amount of beech reproduction remained in the ground cover. The reproductive density of beech in disturbed areas was greater than understory density at the same locations.

6. When comparing understory density to previous research (Russell 1953), Double Springs Gap showed a decrease in beech

understory density. Evidence indicates that hog rooting may be disturbing the natural size distribution of arborescent species in the lower strata.

7. Regressions of basal area per plot versus the number of beech stems per plot indicate that boar rooting was significantly disturbing the understory and reproduction of *F. grandifolia*.

8. The feeding activity of the boar may indirectly represent a potential threat to the reproduction of sugar maple.

9. The foliar height of blackberry (*Rubus canadensis*) was suppressed by hog rooting. There was a significant decrease in the mature arching *Rubus* stems in the disturbed areas. The reproductive stems had the opposite response, with an increased density of shorter stems.

10. A negative or positive effect on rare arborescent species could not be detected in this study.

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Table 1. Species list of woody vegetation on plots sampled in the Gray Beech Forests of the Great Smoky Mountains National Park

Species*	Abbreviation	Common Name
Abies fraseri	Abfr	Fraser's Fir
Acer pensylvanicum	Acpe	Striped Maple
Acer saccharum	Acsa	Sugar Maple
Acer spicatum	Acsp	Mountain Maple
Aesculus octandra	Aeoc	Yellow Buckeye
Amelanchier abores var. *laevis*	Amla	Serviceberry
Betula lenta	Bele	Cherry Birch
Betula lutea	Belu	Yellow Birch
Cornus alternifolia	Coal	Dogwood
Crataegus sp.	Crsp	Hawthorn
Fagus grandifolia	Fagr	Beech
Helesia carolina	Haca	Silverbell
Picea rubrens	Piru	Red Spruce
Prunus pensylvanica	Prpe	Fire Cherry
Prunus seriotina	Prse	Black Cherry
Quercus rubra	Quru	Red Oak
Rubus canadensis	Ruca	Blackberry
Sorbus americana	Soam	Mountain Ash
Vaccinium constablaei	Vaco	
Vaccinium erythrocarpum	Vaer	Bearberry
Viburnum alnifolium	Vial	Hobblebush
Viburnum cassinoides	Vica	Northern Witherod

*See Table 2

Table 2. The relative proportion (percent) of woody species greater than 2.5 centimeters dbh on boar-disturbed plots.

	Location				
	Cold Spring Knob and Hemlock Knob	Derrick Knob	Spence Field to Little Bald	Silers Bald	Jenkins Knob to the Narrows
Species	Percent	Percent	Percent	Percent	Percent
Acpe	0.03	1.8	0.0	0.0	0.0
Acsa	31.2	16.4	0.5	1.6	0.5
Acsp	0.0	0.0	0.2	0.3	0.0
Aeoc	17.8	22.4	14.1	11.9	20.7
Amla	0.0	0.3	0.02	0.0	0.1
Belu	10.3	15.9	23.7	0.0	1.3
Coal	0.1	0.0	0.1	0.0	0.0
Crsp	0.0	0.0	0.0	0.0	0.1
Fagr	36.1	43.4	55.1	81.6	71.7
Haca	4.3	0.0	0.0	0.0	0.0
Piru	0.0	0.0	0.0	4.7	3.7
Prpe	0.0	0.0	0.0	0.0	0.1
Prse	0.0	0.0	2.0	0.0	1.8
Quru	0.04	0.0	4.3	0.0	0.0
Total	100	100	100	100	100

Table 3. The relative proportion (percent) of woody species greater than 2.5 centimeters dbh on plots undisturbed by wild boar.

	Location			
	Newfound Gap	Pauls Gap and Beech Gap	Indian Gap	Mesa Knob
Species*	Percent	Percent	Percent	Percent
Abfr	0.0	0.0	0.3	4.4
Acpe	1.3	0.2	0.1	0.0
Acsa	4.5	7.1	0.0	0.0
Acsp	0.4	0.0	1.3	0.6
Aeoc	5.1	20.8	9.0	0.0
Amla	0.8	0.0	0.0	0.0
Belu	12.1	3.3	21.9	32.9
Coal	0.0	0.03	0.0	0.1
Fagr	63.0	65.4	63.9	45.9
Haca	6.0	0.0	0.0	0.0
Piru	6.6	0.0	3.6	13.1
Prpe	0.0	2.9	0.0	0.9
Quru	0.0	0.2	0.0	0.0
Soam	0.4	0.0	0.0	2.2
Vial	0.02	0.0	0.03	0.0
Total	100	100	100	100

*See Table 2

Table 4. The average basal area (square meters per hectare) of woody species greater than 2.5 centimeters dbh on boar-disturbed plots.

	Location				
	Cold Spring Knob and Hemlock Knob	Derrick Knob	Spence Field to Little Bald	Silers Bald	Jenkins Knob to the Narrows
Species*	m^2	m^2	m^2	m^2	m^2
Acpe	0.01	0.65	0.00	0.00	0.00
Acsa	12.82	6.05	0.20	0.60	0.15
Acsp	0.00	0.00	0.07	0.10	0.00
Aeoc	7.32	8.27	5.41	4.31	6.10
Amla	0.00	0.10	0.01	0.00	0.01
Belu	4.22	5.87	9.11	0.00	0.37
Coal	0.03	0.00	0.03	0.00	0.03
Fagr	14.82	16.02	21.19	34.62	22.12
Haca	1.80	0.00	0.00	0.00	0.00
Piru	0.00	0.00	0.00	1.69	1.10
Prpe	0.00	0.00	0.00	0.00	0.04
Prse	0.00	0.00	0.78	0.00	0.54
Quru	0.02	0.00	1.65	0.00	0.00
Avg/hectare	41.04	36.96	38.45	41.32	30.46

*See Table 2

Table 5. The average basal area (square meters per hectare) of woody species greater than 2.5 centimeters dbh on plots undisturbed by wild boar.

	Location			
	Newfound Gap	Pauls Gap and Beech Gap	Indian Gap	Mesa Knob
Species*	m^2	m^2	m^2	m^2
Abfr	0.00	0.00	.09	1.50
Acpe	0.60	0.07	0.04	0.00
Acsa	2.08	2.71	0.00	0.00
Acsp	0.17	0.00	0.43	0.19
Aeoc	2.35	7.91	2.98	0.00
Amla	0.36	0.00	0.00	0.00
Belu	5.61	1.24	7.28	11.17
Coal	0.00	0.01	0.00	0.04
Fagr	29.27	24.82	21.21	15.60
Haca	2.78	0.00	0.00	0.00
Piru	3.05	0.00	1.18	4.44
Prpe	0.00	1.10	0.00	0.00
Quru	0.00	0.08	0.00	0.31
Soam	0.20	0.00	0.00	0.75
Vial	0.01	0.00	0.01	0.00
Avg/hectare	46.48	37.94	33.22	34.00

*See Table 2

Table 6. The proportion (percent) of woody species in the understory of hog-disturbed sites.

	Location				
	Cold Spring Knob and Hemlock Knob	Derrick Knob	Spence Field to Little Bald	Silers Bald	Jenkins Knob to the Narrows
Species*	Percent	Percent	Percent	Percent	Percent
Acpe	0.0	1.3	0.0	0.0	0.0
Acsa	22.1	28.9	0.0	0.0	0.0
Acsp	0.0	0.0	0.0	5.6	0.0
Aeoc	1.6	13.2	2.1	7.4	4.8
Amla	0.0	1.3	0.0	0.0	0.0
Belu	0.0	0.0	0.8	0.0	0.0
Coal	0.5	0.0	0.8	0.0	0.0
Crsp	0.5	0.0	0.4	0.0	0.0
Fagr	17.9	55.3	32.9	81.5	83.8
Piru	0.0	0.0	0.0	0.0	0.0
Quru	0.5	0.0	0.0	0.0	0.0
Ruca	57.4	0.0	62.9	0.0	10.5
Vial	0.0	0.0	0.0	5.6	0.0
Total	100	100	100	100	100

*See Table 2

Table 7. The proportion (percent) of woody species in the understory on sites not disturbed by hogs.

	Location			
	Newfound Gap	Pauls Gap and Beech Gap	Indian Gap	Mesa Knob
Series*	Percent	Percent	Percent	Percent
Abfr	0.0	0.0	0.0	0.0
Acpe	0.8	0.0	0.6	0.0
Acsa	0.0	17.6	0.0	0.0
Acsp	4.2	0.0	1.9	1.7
Aeoc	1.1	3.6	0.0	0.0
Belu	0.3	0.6	0.6	0.0
Coal	0.0	2.4	0.0	0.9
Fagr	22.3	39.9	10.9	26.0
Haca	0.6	0.0	0.0	0.0
Piru	0.3	0.0	1.3	0.0
Prpr	0.0	0.6	0.0	0.0
Ruca	24.3	31.5	49.8	62.1
Soam	0.0	0.0	0.6	0.4
Vaco	4.5	0.0	0.0	0.4
Vaer	0.6	0.0	0.0	4.6
Vial	40.6	1.8	33.4	3.0
Vica	1.7	0.0	0.0	0.0
Total	100	100	100	100

*See Table 2

Table 8. The proportion (percent) of woody species reproduction on hog-disturbed sites.

Species*	Cold Spring Knob and Hemlock Knob Percent	Derrick Knob Percent	Spence Field to Little Bald Percent	Silers Bald Percent	Jenkins Knob to the Narrows Percent
Acsa	2.2	2.7	0.2	0.0	0.0
Acsp	0.0	0.0	0.0	0.4	0.0
Aeoc	1.4	5.4	1.1	1.2	0.3
Amla	0.0	0.0	0.0	0.0	0.3
Coal	0.0	0.0	0.4	0.0	0.0
Crsp	0.0	0.0	0.0	0.0	1.0
Fagr	18.8	91.8	48.8	91.2	82.0
Prpe	0.4	0.0	0.2	0.0	0.0
Quru	0.0	0.0	0.4	0.0	0.0
Ruca	76.1	0.0	49.0	6.0	16.2
Vial	1.1	0.0	0.0	1.2	0.0
Total	100	100	100	100	100

*See Table 2

Table 9. The proportion (percent) of woody species reproduction on sites not disturbed by hogs.

	Location			
	Newfound Gap	Pauls Gap and Beech Gap	Indian Gap	Mesa Knob
Species*	Percent	Percent	Percent	Percent
Abfr	0.0	0.0	0.4	18.4
Acpe	0.5	0.0	1.7	0.0
Acsa	1.5	28.3	0.0	0.0
Acsp	3.6	0.0	0.4	0.0
Aeoc	1.0	4.1	0.0	0.0
Coal	0.0	0.7	0.8	0.0
Fagr	8.2	11.0	8.5	7.1
Piru	0.0	0.0	0.0	1.0
Prpe	1.0	2.1	0.4	0.0
Prse	0.0	1.4	0.0	0.0
Quru	0.0	0.7	0.0	0.0
Ruca	32.3	46.9	43.6	66.3
Soam	0.0	0.0	0.4	0.0
Vaco	0.0	0.0	0.0	2.0
Vaer	4.6	0.0	0.0	0.0
Vial	45.6	4.8	43.6	5.1
Vica	1.5	0.0	0.0	0.0
Total	100	100	100	100

*See Table 2

Table 10. The proportion of overstory basal area (square meters per hectare), the average number of stems per plot, and relative frequency of *Aesculus octandra* in disturbed and undisturbed understory (U) and reproduction (R) plots.

	Undisturbed plots				Reproduction plots	
Location*	No. of plots	Overstory basal area m /ha	Avg. no. of stems/ plot	Rel. % frequency/ site	Avg. no. of stems/ plot	Rel. % frequency/ site
Damaged						
Cold Spring Knob and Hemlock Knob	9	7.3	0.3	33.3	0.4	22.2
Derrick Knob	8	8.3	1.3	50.0	1.3	75.0
Spence Field to Little Bald	14	5.4	0.4	35.7	0.3	14.3
Silers Bald	7	4.3	0.6	28.6	0.8	57.1
Jenkins Knob to the Narrows	25	6.1	0.2	8.0	0.2	16.0
Undamaged						
Newfound Gap	11	2.4	0.4	9.1	0.2	18.2
Pauls Gap and Beech Gap	10	7.9	0.6	30.0	0.6	50.0
Indian Gap	14	3.0	0.0	0.0	0.0	0.0
Mesa Knob	17	0.0	0.0	0.0	0.0	0.0

*See Figure 1 and Table 1

Table 11. The proportion of overstory basal area (square meters per hectare), average number of stems per plot, and relative frequency of *Acer saccharum* in disturbed and undisturbed understory (U) and reproduction (R) plots.

		U-plots			R-plots	
Location*	No. of plots	Overstory basal area m^2/ha	Avg. no. of stems/ plot	Rel. % frequency/ site	Avg. no. of stems/ plot	Rel. % frequency/ site
Damaged						
Cold Spring Knob and Hemlock Knob	9	12.8	4.7	55.6	0.7	33.3
Derrick Knob	8	6.0	2.8	50.0	0.6	50.0
Spence Field to Little Bald	14	0.2	0.0	0.0	0.1	7.1
Silers Bald	7	0.6	0.0	0.0	0.0	0.0
Jenkins Knob to the Narrows	25	0.2	0.0	0.0	0.0	0.0
Undamaged						
Newfound Gap	11	2.1	0.0	0.0	0.3	9.1
Pauls Gap and Beech Gap	10	2.7	3.3	70.0	4.1	60.0
Indian Gap	14	0.0	0.0	0.0	0.0	0.0
Mesa Knob	17	0.0	0.0	0.0	0.0	0.0

*See Figure 1 and Table 1

Table 12. The average number of stems per plot and relative frequency of Rubus canadensis in disturbed and undisturbed understory (U) and reproduction (R) plots

Location*	No. of plots	Avg. no. of stems/plot	Rel. percent frequency Site	Avg. no. of stems/plot	Rel. percent frequency/site
Damaged					
Cold Spring Knob and Hemlock Knob	9	12.1	66.7	23.3	66.7
Derrick Knob	8	0.0	0.0	0.0	0.0
Spence Field to Little Bald	14	10.8	50.0	16.5	57.1
Silers Bald	7	0.0	0.0	4.3	42.9
Jenkins Knob to the Narrows	25	0.4	20.0	6.0	68.0
Undamaged					
Newfound Gap	11	4.1	36.4	5.7	45.4
Pauls Gap and Beech Gap	10	5.3	60.0	6.8	70.0
Indian Gap	14	11.1	50.0	7.4	64.3
Mesa Knob	7	8.6	47.1	3.8	58.8

*See Figure 1 and Table 1

Table 13. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Jenkins Knob to the Narrows

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
1	1686	180	5.0	3.3
2	1686	180	10.3	8.4
3	1686	200	12.0	2.7
4	1686	310	9.0	5.9
5	1686	230	12.0	7.0
6	1661	300	12.0	9.5
7	1658	290	13.3	9.4
8	1661	330	8.8	4.1
9	1658	340	4.0	3.0
10	1658	350	5.5	5.4
11	1655	0	2.3	2.2
12	1661	140	10.3	6.8
13	1658	200	21.3	14.2
14	1658	200	8.0	3.8
15	1695	320	0.3	0.1
16	1692	Flat	16.0	6.7
17	1670	20	9.5	2.9
18	1670	20	9.0	5.9
19	1673	20	8.3	3.3
20	1670	60	17.5	2.4
21	1670	0	14.5	2.1
22	1670	0	9.3	4.2
23	1682	110	33.8	4.7
24	1682	120	23.8	1.4
25	1690	15	7.8	7.6

Table 14. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Cold Spring Knob and Hemlock Knob

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
26	1451	290	27.5	9.1
27	1451	0	14.3	2.1
28	1451	340	37.5	0.4
29	1561	280	10.3	0.5
30	1561	270	33.3	12.4
31	1561	250	20.0	7.7
32	1530	300	20.0	14.9
33	1530	340	27.0	11.7
34	1530	310	15.0	4.2

Table 15. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Spence Field to Little Bald

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
35	1527	310	6.8	2.9
36	1527	Flat	9.3	6.6
37	1527	0	14.5	9.0
38	1527	330	13.8	5.2
39	1527	350	12.5	3.0
40	1527	330	12.0	3.6
41	1524	280	3.8	3.3
42	1524	280	9.0	2.4
43	1539	110	60.0	25.4
44	1536	90	53.8	30.6
45	1487	0	20.0	7.4
46	1487	350	4.0	1.0
47	1512	0	8.8	5.4
48	1515	50	19.5	4.4

Table 16. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Derrick Knob

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
49	1518	10	5.0	0.3
50	1515	10	3.3	0.7
51	1515	340	16.8	6.4
52	1463	310	13.3	8.9
53	1469	20	22.0	2.4
54	1475	20	9.5	5.1
55	1487	20	7.5	2.5
56	1483	30	10.8	7.7

Table 17. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Silers Bald

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
57	1646	250	25.0	7.6
58	1646	270	13.5	8.2
59	1628	275	31.3	12.0
60	1631	280	15.5	7.3
61	1615	350	15.8	11.5
62	1615	350	37.5	5.2
63	1615	340	13.3	5.2

Table 18. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Newfound Gap

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
64	1609	280	82.5	9.1
65	1585	290	59.8	3.7
66	1585	290	88.8	11.3
67	1555	350	5.0	1.9
68	1555	350	12.0	0.5
69	1542	20	10.3	2.5
70	1518	200	27.5	0.2
71	1512	190	63.8	6.4
72	1542	210	18.8	8.8
73	1542	200	20.0	1.5
74	1548	220	23.8	0.4

Table 19. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Indian Gap

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
75	1655	20	53.8	8.6
76	1655	130	14.3	0.6
77	1661	40	43.8	6.2
78	1628	200	2.5	1.0
79	1640	210	7.5	1.4
80	1646	60	48.8	6.1
81	1646	350	20.0	6.0
82	1646	0	57.5	4.5
83	1640	140	16.8	2.6
84	1646	160	35.0	13.0
85	1646	200	18.0	4.6
86	1646	10	22.5	7.5
87	1646	20	17.5	1.2
88	1646	190	2.5	0.0

Table 20. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Mesa Knob

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
89	1701	340	3.8	0.0
90	1701	0	5.8	0.4
91	1701	330	12.5	2.3
92	1707	280	0.0	0.0
93	1713	290	6.3	0.0
94	1722	310	42.5	3.8
95	1725	160	41.3	8.4
96	1725	10	10.0	0.0
97	1701	330	13.8	1.0
98	1725	170	7.5	4.7
99	1725	150	5.0	0.0
100	1725	170	8.3	0.2
101	1725	180	8.3	1.1
102	1725	180	11.5	7.1
103	1683	200	15.8	1.3
104	1683	200	3.0	0.3
105	1683	220	3.3	0.0

Table 21. The site characteristics of each plot and the average percent cover for U-plots and R-plots

Location: Pauls Gap and Beech Gap

Plot No.	Elevation (meters)	Aspect (degrees)	Avg percent cover U-plots	Avg percent cover R-plots
106	1561	80	21.3	1.4
107	1561	120	25.0	4.3
108	1561	350	22.5	2.3
109	1561	350	43.8	6.4
110	1561	350	35.0	5.5
111	1545	Flat	17.5	5.0
112	1548	70	26.3	9.1
113	1548	20	17.5	0.4
114	1551	80	32.5	2.4
115	1551	60	15.0	3.3

Table 22. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech Forest plots

Location: Jenkins Knob to the Narrows

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	3	0	0	0	0
3	0	0	0	0	4	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	3	0	0	0	0
6	0	0	0	0	2	0	0	1	0
7	0	0	0	0	1	1	0	0	0
8	0	0	0	0	1	0	0	0	0
9	0	0	0	0	3	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	1	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	2	0	0	0	0
14	0	0	0	0	2	0	0	0	0
15	0	0	0	0	4	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	2	0	0	0	0
18	0	0	0	0	1	0	0	0	0
19	0	0	0	0	5	0	0	0	0
20	0	0	0	0	5	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	0	0	0	0	1	0	0	0	0
23	0	0	0	0	3	0	0	0	0
24	0	0	0	0	1	0	0	0	0
25	0	0	1	0	0	0	0	0	0

Table 22. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech Forest plots - Cont.

Location: Jenkins Knob to the Narrows

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
1	0	13	0	0	0	0	0	0	0
2	0	21	0	0	0	0	0	0	0
3	0	21	0	0	0	0	0	0	0
4	0	21	0	0	0	0	0	0	0
5	0	12	0	0	0	0	0	0	0
6	0	10	0	0	0	0	0	0	0
7	0	16	0	1	0	0	0	0	0
8	0	6	0	0	0	0	0	0	0
9	0	4	0	0	0	1	0	0	0
10	1	23	0	0	0	0	0	0	0
11	0	3	0	0	0	0	0	0	0
12	0	54	0	0	1	0	0	0	0
13	0	25	0	0	0	0	0	0	0
14	1	19	0	0	0	0	0	0	0
15	0	25	0	1	0	0	0	0	0
16	0	12	0	2	0	0	0	0	0
17	0	34	0	1	0	0	0	0	0
18	0	21	0	0	0	0	0	0	0
19	0	19	0	0	0	0	0	0	0
20	0	8	0	0	1	0	0	0	0
21	0	16	0	0	0	0	0	0	0
22	0	12	0	1	0	0	0	0	0
23	0	31	0	0	0	0	0	0	0
24	0	28	0	0	0	0	0	0	0
25	0	36	0	3	0	0	0	0	0

Table 23. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Cold Spring Knob and Hemlock Knob

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
26	0	0	1	0	1	0	0	0	0
27	0	1	1	0	0	0	2	2	
28	0	0	7	0	0	0	0	0	0
29	0	0	0	0	3	0	0	0	0
30	0	0	0	0	1	0	0	0	0
31	0	0	2	0	1	0	0	0	0
32	0	0	0	0	1	0	0	0	0
33	0	0	1	0	1	0	0	0	0
34	0	0	5	0	1	0	0	0	0

Table 23. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Cold Spring Knob and Hemlock Knob

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
26	0	12	2	0	0	0	1	0	0
27	0	15	0	0	0	0	0	0	0
28	0	12	0	0	0	0	0	0	0
29	0	18	0	0	0	0	0	0	0
30	0	11	0	0	0	0	0	0	0
31	0	18	0	0	0	0	0	0	0
32	0	4	0	0	0	0	0	0	0
33	0	11	0	0	0	0	0	0	0
34	0	3	0	0	0	0	0	0	0

Table 24. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Spence Field to Little Bald

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
35	0	0	0	1	0	0	0	6	0
36	0	0	0	0	0	0	0	1	0
37	0	0	1	0	1	0	0	10	0
38	0	0	1	0	0	0	0	5	0
39	0	0	0	0	0	0	1	6	0
40	0	0	1	0	5	0	0	13	0
41	0	0	0	0	2	0	0	6	0
42	0	0	0	0	2	0	0	0	0
43	0	0	0	0	1	0	0	0	0
44	0	0	0	0	1	0	0	0	0
45	0	0	1	0	3	0	0	0	0
46	0	0	0	0	3	0	0	0	0
47	0	0	0	0	1	0	0	1	0
48	0	0	0	0	0	0	0	2	1

Table 24. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Spence Field to Little Bald

Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
35	0	24	0	0	0	0	0	0	0
36	0	53	0	0	0	1	0	0	0
37	0	12	0	0	0	0	0	0	0
38	0	8	0	0	0	0	0	0	0
39	0	17	0	0	0	0	0	0	0
40	0	9	0	0	0	0	0	0	0
41	0	13	0	0	0	0	0	0	0
42	0	22	0	0	0	0	0	0	0
43	0	24	0	0	0	0	0	0	0
44	0	21	0	0	0	0	0	0	0
45	0	14	0	0	0	0	0	0	0
46	0	15	0	0	0	0	0	0	0
47	0	24	0	0	0	0	0	0	0
48	0	14	0	0	0	0	0	0	0

Table 25. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Derrick Knob

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
49	0	0	7	0	0	0	0	3	0
50	0	0	2	0	10	0	0	0	0
51	0	0	11	0	2	0	0	0	0
52	0	0	0	0	0	0	0	0	0
53	0	0	5	0	0	2	0	1	0
54	0	5	1	0	3	0	0	1	0
55	0	0	2	0	1	0	0	1	0
56	0	0	8	0	2	0	0	0	0

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
49	0	6	0	0	0	0	0	0	0
50	0	9	0	0	0	0	0	0	0
51	0	4	0	0	0	0	0	0	0
52	0	11	0	0	0	0	0	0	0
53	0	5	0	0	0	0	0	0	0
54	0	2	0	0	0	0	0	0	0
55	0	10	0	0	0	0	0	0	0
56	0	19	0	0	0	0	0	0	0

Table 26. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Silers Bald

				Species					
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
57	0	0	0	2	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0
59	0	0	0	4	0	0	0	0	0
60	0	0	0	2	1	0	0	0	0
61	0	0	0	0	1	0	0	0	0
62	0	0	0	0	1	0	0	0	0
63	0	0	2	0	1	0	0	0	0

				Species					
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
57	0	22	0	0	0	0	0	0	0
58	0	16	0	0	0	0	0	0	0
59	0	22	0	0	0	0	0	0	0
60	0	22	0	0	0	0	0	0	0
61	0	11	0	0	0	0	0	0	0
62	0	16	0	0	0	0	0	0	0
63	0	16	0	0	0	0	0	0	0

Table 27. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Newfound Gap

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
64	0	0	0	0	0	0	0	1	0
65	0	0	0	0	0	0	0	2	0
66	0	0	0	0	0	0	0	0	0
67	0	9	0	3	0	0	0	1	0
68	0	4	0	6	0	0	0	0	0
69	0	0	0	0	0	1	0	0	0
70	0	0	1	0	0	0	0	0	0
71	0	0	1	0	0	0	0	0	0
72	0	0	0	0	0	0	0	0	0
73	0	0	0	0	2	0	0	0	0
74	0	0	0	0	0	0	0	0	0

Table 27. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Newfound Gap

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
64	0	5	0	1	0	0	0	0	0
65	0	9	0	0	0	0	0	0	0
66	0	21	0	1	0	0	0	0	0
67	0	42	0	1	0	0	0	1	0
68	0	20	3	4	0	0	0	0	0
69	0	20	0	0	0	0	0	0	1
70	0	4	1	3	0	0	0	0	0
71	0	11	1	1	0	0	0	0	0
72	0	17	0	1	0	0	0	0	0
73	0	12	0	0	0	0	0	0	0
74	0	29	0	0	0	0	0	0	0

Table 28. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Indian Gap

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
75	0	0	0	1	0	0	0	0	0
76	0	0	0	0	0	0	0	0	0
77	3	0	0	0	0	0	0	1	0
78	0	0	0	0	2	0	0	0	0
79	0	0	0	0	1	0	0	0	0
80	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0
82	0	0	0	1	0	0	0	2	0
83	0	0	0	0	1	0	0	0	0
84	0	0	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0	1	0
86	0	2	0	0	0	0	0	1	0
87	0	0	0	4	0	0	0	2	0
88	0	0	0	0	0	0	0	1	0

Table 28. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Indian Gap

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
75	0	14	0	0	0	0	0	0	0
76	0	29	0	0	0	0	0	0	0
77	0	16	0	0	0	0	0	0	0
78	0	8	0	0	0	0	0	0	0
79	0	4	0	1	0	0	0	0	0
80	0	7	0	5	0	0	0	0	0
81	0	9	0	3	0	0	0	0	0
82	0	10	0	8	0	0	0	0	1
83	0	8	0	0	0	0	0	0	0
84	0	27	0	0	0	0	0	0	0
85	0	25	0	0	0	0	0	0	0
86	0	10	0	6	0	0	0	0	1
87	0	10	0	0	0	0	0	0	0
88	0	13	0	0	0	0	0	0	0

Table 29. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Mesa Knob

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
89	0	0	0	0	0	0	0	0	0
90	3	0	0	0	0	0	0	5	0
91	1	0	0	0	0	0	0	1	0
92	0	0	0	1	0	0	0	0	0
93	0	0	0	0	0	0	0	0	0
94	1	0	0	0	0	0	0	0	0
95	0	0	0	0	0	0	0	0	0
96	0	0	0	4	0	0	0	3	0
97	2	0	0	0	0	0	0	0	0
98	1	0	0	2	0	0	0	0	0
99	0	0	0	0	0	0	0	0	0
100	1	0	0	0	0	0	0	1	0
101	0	0	0	0	0	0	0	2	0
102	0	0	0	0	0	0	0	0	0
103	1	0	0	0	0	0	0	0	3
104	4	0	0	0	0	0	0	1	0
105	1	0	0	0	0	0	0	2	0

Table 29. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Mesa Knob

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
89	0	5	0	1	0	0	0	0	0
90	0	4	0	1	0	0	0	1	0
91	0	2	0	1	0	0	0	0	0
92	0	12	0	0	0	0	0	0	0
93	0	8	0	0	0	0	0	0	0
94	0	19	0	0	0	0	0	0	0
95	0	29	0	0	0	0	0	0	0
96	0	0	0	0	0	0	0	2	0
97	0	7	0	0	0	0	0	0	0
98	0	13	0	0	0	0	0	0	0
99	0	16	0	0	0	0	0	1	0
100	0	14	0	0	0	0	0	0	0
101	0	3	0	0	0	0	0	0	0
102	0	25	0	0	0	0	0	0	0
103	0	17	0	0	0	0	0	0	0
104	0	15	0	3	0	0	0	0	0
105	0	6	0	0	0	0	0	0	0

Table 30. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Pauls Gap and Beech Gap

	Species								
Plot No.	Abfr	Acpe	Acsa	Acsp	Aeoc	Amla	Bele	Belu	Coal
106	0	0	1	0	1	0	0	0	0
107	0	0	0	0	1	0	0	0	1
108	0	0	1	0	1	0	0	0	0
109	0	0	0	0	0	0	0	0	0
110	0	0	1	0	0	0	0	0	0
111	0	0	1	0	2	0	0	0	0
112	0	1	0	0	2	0	0	3	0
113	0	0	0	0	4	0	0	1	0
114	0	0	0	0	13	0	0	0	0
115	0	0	0	0	15	0	0	0	0

Table 30. Number of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Pauls Gap and Beech Gap

	Species								
Plot No.	Crsp	Fagr	Haca	Piru	Prpe	Prse	Quru	Soam	Vial
106	0	8	0	0	0	0	0	0	0
107	0	8	0	0	0	0	0	0	0
108	0	9	0	0	0	0	0	0	0
109	0	17	0	0	0	0	0	0	0
110	0	6	0	0	0	0	0	0	0
111	0	2	0	0	1	0	0	0	0
112	0	5	0	0	0	0	1	0	0
113	0	16	0	0	0	0	0	0	0
114	0	31	0	0	0	0	0	0	0
115	0	23	0	0	0	0	0	0	0

Table 31. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Jenkins Knob to the Narrows

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
1	Fagr	4	24
2	Aeoc	0	1
2	Fagr	1	80
3	Aeoc	1	0
3	Fagr	4	29
4	Fagr	4	6
4	Ruca	5	9
5	Aeoc	4	0
5	Fagr	2	41
5	Ruca	0	9
6	Fagr	2	41
6	Ruca	0	26
7	Amla	0	2
7	Fagr	1	67
7	Ruca	0	1
8	Aeoc	0	2
8	Fagr	2	27
8	Ruca	0	1
9	Fagr	1	14
9	Ruca	1	8
10	Crsp	0	7
10	Fagr	3	24
11	Fagr	1	15
11	Ruca	0	1
12	Fagr	4	43
12	Ruca	0	4
13	Crsp	0	2
13	Fagr	9	40
13	Ruca	1	28

Table 31. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Jenkins Knob to the Narrows

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
14	Amla	0	1
14	Fagr	4	13
15	Fagr	0	3
16	Fagr	6	47
16	Ruca	1	2
17	Fagr	3	45
17	Piru	1	0
18	Aeoc	0	1
18	Fagr	0	21
18	Ruca	3	16
19	Fagr	0	29
19	Ruca	0	11
20	Aeoc	0	1
20	Fagr	5	11
20	Ruca	0	4
21	Fagr	7	19
21	Ruca	0	7
22	Fagr	3	28
22	Ruca	0	10
23	Fagr	10	34
23	Ruca	0	3
24	Fagr	11	16
25	Fagr	1	44

Table 32. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Cold Spring Knob and Hemlock Knob

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
26	Acsa	4	3
26	Aeoc	0	3
26	Fagr	9	4
26	Ruca	25	25
27	Acsa	3	0
27	Fagr	4	10
28	Acsa	20	0
28	Coal	1	0
28	Fagr	2	3
28	Quru	1	0
29	Fagr	6	3
30	Fagr	4	17
30	Ruca	20	41
31	Fagr	2	9
31	Ruca	29	35
32	Acsa	0	1
32	Fagr	1	0
32	Ruca	18	57
33	Acsa	12	0
33	Aeoc	1	1
33	Fagr	5	6
33	Prpe	0	1
33	Ruca	15	39
33	Vial	0	1
34	Acsa	3	2
34	Aeoc	2	0
34	Crsp	1	0
34	Fagr	1	0
34	Ruca	2	13
34	Vial	0	2

Table 33. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Spence Field to Little Bald

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
35	Aeoc	0	1
35	Fagr	2	16
35	Prpe	0	1
36	Aeoc	1	0
36	Fagr	0	1
36	Quru	0	2
36	Ruca	9	24
37	Acsa	0	1
37	Aeoc	0	2
37	Fagr	0	4
37	Ruca	11	29
38	Fagr	8	18
38	Ruca	1	7
39	Aeoc	1	0
39	Fagr	12	16
40	Aeoc	1	0
40	Fagr	3	7
40	Ruca	0	4
41	Crsp	1	0
41	Fagr	1	19
42	Fagr	4	12
43	Fagr	3	6
43	Ruca	67	57
44	Coal	0	2
44	Fagr	16	10
44	Ruca	61	87
45	Fagr	17	30
45	Ruca	1	22
46	Aeoc	2	2
46	Fagr	6	9
47	Belu	1	0
47	Fagr	5	9
48	Belu	1	0
48	Coal	2	0
48	Fagr	2	36
48	Ruca	0	1

Table 34. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Derrick Knob

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
49	Aeoc	3	2
49	Fagr	1	0
50	Fagr	5	5
51	Acsa	1	1
51	Aeoc	0	2
51	Fagr	11	0
52	Acsa	0	1
52	Aeoc	1	1
52	Fagr	15	38
53	Acpe	1	0
53	Acsa	12	2
53	Aeoc	2	1
53	Fagr	3	22
54	Acsa	6	1
54	Aeoc	4	0
54	Amla	1	0
54	Fagr	3	35
55	Aeoc	0	1
55	Fagr	2	13
56	Acsa	3	0
56	Aeoc	0	3
56	Fagr	2	52

Table 35. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Silers Bald

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
57	Fagr	6	83
57	Ruca	0	3
58	Aeoc	0	2
58	Fagr	2	109
59	Aeoc	1	2
59	Fagr	11	84
60	Acsp	2	0
60	Fagr	9	74
60	Ruca	0	4
61	Acsp	1	2
61	Fagr	0	30
61	Ruca	0	23
62	Aeoc	0	1
62	Fagr	12	53
62	Vial	3	6
63	Aeoc	3	1
63	Fagr	4	25

Table 36. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Newfound Gap

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
64	Fagr	1	0
64	Piru	1	0
64	Ruca	5	8
64	Vaco	16	8
64	Vaer	2	0
64	Vial	53	19
64	Vica	6	3
65	Acsa	0	3
65	Acsp	8	0
65	Aeoc	0	1
65	Belu	1	0
65	Fagr	3	4
65	Vial	21	14
66	Fagr	16	0
66	Vial	41	36
67	Acpe	0	1
67	Acsp	5	4
67	Fagr	0	1
67	Ruca	0	1
67	Vial	6	10
68	Acsp	1	0
68	Fagr	3	0
68	Haca	2	0
68	Vial	11	3
69	Acpe	1	0
69	Acsp	1	3
69	Fagr	4	7
69	Prpe	0	2
69	Vaco	0	1
69	Vial	7	4
70	Aeoc	4	1
70	Fagr	6	0
70	Ruca	4	0
71	Fagr	17	2
71	Ruca	38	18
71	Vial	6	3

Table 36. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Newfound Gap

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
72	Fagr	7	0
72	Ruca	11	31
73	Acpe	2	0
73	Fagr	7	0
73	Ruca	25	5
74	Fagr	15	2

Table 37. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Indian Gap

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
75	Acsp	3	0
75	Fagr	1	0
75	Vial	21	28
76	Abfr	0	1
76	Fagr	7	1
77	Abfr	2	0
77	Piru	1	0
77	Ruca	33	23
77	Soam	2	1
77	Vial	7	0
78	Fagr	1	4
78	Ruca	0	2
79	Fagr	4	0
79	Piru	1	0
79	Ruca	12	4
80	Acsp	3	1
80	Coal	0	2
80	Fagr	1	4
80	Ruca	40	11
80	Vial	10	11
81	Fagr	0	3
81	Piru	1	0
81	Vial	13	27
82	Acpe	1	0
82	Belu	2	0
82	Fagr	1	0
82	Piru	1	0
82	Ruca	12	6
82	Vial	26	16
83	Fagr	6	0
83	Ruca	25	5
84	Fagr	7	4
84	Prpe	0	1
84	Ruca	23	37

Table 37. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Indian Gap

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
85	Fagr	4	4
85	Ruca	10	14
86	Acpe	1	4
86	Ruca	0	1
86	Vial	16	15
87	Fagr	1	0
87	Vial	10	6
88	Fagr	1	0

Table 38. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Mesa Knob

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
89	Fagr	2	0
90	Fagr	3	0
90	Ruca	1	2
91	Fagr	2	1
91	Ruca	12	4
91	Soam	1	0
92	-	0	0
93	Fagr	4	0
94	Fagr	3	0
94	Ruca	54	13
94	Vaco	11	2
95	Abfr	2	0
95	Fagr	9	1
95	Ruca	46	23
96	Acsp	4	0
96	Vial	1	0
97	Fagr	5	0
97	Ruca	16	2
98	Abfr	0	15
98	Fagr	2	0
98	Piru	0	1
99	Fagr	3	0
99	Vaer	1	0
100	Fagr	9	0
100	Ruca	0	1
100	Vial	2	0
101	Fagr	3	1
101	Ruca	3	4

Table 38. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Mesa Knob

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
102	Abfr	0	3
102	Fagr	1	1
102	Ruca	12	14
102	Vial	3	4
103	Fagr	11	3
103	Ruca	2	1
103	Vial	1	1
104	Coal	2	0
104	Fagr	2	0
104	Ruca	0	1
105	Fagr	2	0

Table 39. Number of woody species less than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Pauls Gap and Beech Gap

Plot No.	Species	No. greater than 40 cm in height	No. less than 40 cm in height
106	Acsa	0	3
106	Aeoc	0	1
106	Belu	1	0
106	Fagr	10	1
107	Acsa	5	3
107	Aeoc	3	1
107	Coal	3	0
107	Fagr	1	0
107	Ruca	4	8
108	Acsa	1	0
108	Aeoc	0	1
108	Fagr	11	2
108	Ruca	4	5
109	Acsa	7	20
109	Aeoc	1	0
109	Fagr	18	0
109	Vial	3	7
110	Acsa	16	12
110	Aeoc	0	1
110	Fagr	3	1
110	Prse	1	2
110	Ruca	2	5
111	Aeoc	0	2
111	Ruca	14	8
112	Fagr	2	1
112	Prpe	0	3
112	Ruca	28	29
113	Acsa	1	0
113	Aeoc	2	0
113	Fagr	10	3
114	Acsa	2	2
114	Fagr	7	5
114	Ruca	0	3
115	Acsa	1	1
115	Coal	1	1
115	Fagr	5	3
115	Quru	0	1
115	Ruca	1	10

Table 40. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Jenkins Knob to the Narrows

Plot No.	Species	Basal area	Relative dominance
1	Fagr	3218	100.00
2	Aeoc	868	22.85
2	Fagr	2930	77.15
3	Fagr	3260	100.00
4	Fagr	2995	100.00
5	Aeoc	1448	69.56
5	Fagr	634	30.44
6	Aeoc	1026	37.77
6	Belu	305	11.22
6	Fagr	1386	51.01
7	Aeoc	515	23.37
7	Amla	36	1.65
7	Fagr	1365	61.98
7	Piru	287	13.01
8	Aeoc	539	44.50
8	Fagr	673	55.50
9	Aeoc	490	25.13
9	Fagr	753	38.61
9	Prse	707	36.26
10	Crsp	65	2.28
10	Fagr	2783	97.72
11	Aeoc	1327	61.29
11	Belu	628	29.00
11	Fagr	210	9.71
12	Fagr	4381	100.00
13	Aeoc	438	12.33
13	Fagr	3110	87.67

Table 40. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Jenkins Knob to the Narrows

Plot No.	Species	Basal area	Relative dominance
14	Aeoc	611	24.21
14	Crsp	5	0.21
14	Fagr	1907	75.58
15	Aeoc	384	11.71
15	Fagr	2003	61.03
15	Piru	881	26.86
16	Fagr	2857	88.80
16	Piru	360	11.20
17	Aeoc	666	21.64
17	Fagr	2385	77.50
17	Piru	26	0.86
18	Aeoc	412	15.64
18	Fagr	2222	84.36
19	Aeoc	2243	78.58
19	Fagr	611	21.42
20	Aeoc	1190	78.78
20	Fagr	428	16.96
20	Prpe	108	4.26
21	Fagr	2347	100.00
22	Aeoc	293	7.87
22	Fagr	2770	74.50
22	Piru	22	0.59
22	Prse	633	17.04
23	Aeoc	1320	43.53
23	Fagr	1712	56.47
24	Aeoc	1476	38.27
24	Fagr	2381	61.73
25	Acsa	380	7.53
25	Fagr	3484	69.04
25	Piru	1182	23.43

Table 41. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Cold Spring Knob and Hemlock Knob

Plot No.	Species	Basal area	Relative dominance
26	Acsa	9	0.21
26	Aeoc	1081	24.50
26	Fagr	1684	38.16
26	Haca	1624	36.80
26	Quru	15	0.33
27	Acpe	10	0.18
27	Acsa	12	0.23
27	Belu	3800	72.22
27	Coal	25	0.48
27	Fagr	1415	26.89
28	Acsa	215	25.67
28	Fagr	622	74.33
29	Aeoc	1648	37.68
29	Fagr	2726	62.32
30	Aeoc	235	6.09
30	Fagr	3623	93.91
31	Acsa	3781	91.26
31	Aeoc	137	3.30
31	Fagr	163	7.80
32	Aeoc	1932	92.20
32	Fagr	163	7.80
33	Acsa	3600	52.66
33	Aeoc	1534	22.45
33	Fagr	1702	24.90
34	Acsa	3930	76.54
34	Aeoc	22	0.43
34	Fagr	1183	23.04

Table 42. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Spence Field to Little Bald

Plot No.	Species	Basal area	Relative dominance
35	Acsp	11	0.30
35	Amla	13	0.35
35	Belu	3141	87.01
35	Fagr	446	12.34
36	Belu	137	4.88
36	Fagr	2665	95.12
37	Acsa	117	1.41
37	Aeoc	962	11.62
37	Belu	849	10.25
37	Fagr	5276	63.70
37	Prse	1078	13.02
38	Acsa	24	1.24
38	Belu	583	30.33
38	Fagr	1315	68.43
39	Belu	6284	92.70
39	Fagr	477	7.04
39	Prse	17	0.26
40	Acsa	79	1.88
40	Aeoc	2476	59.19
40	Belu	1257	30.04
40	Fagr	372	8.89
41	Aeoc	1462	22.35
41	Belu	412	6.29
41	Fagr	4654	71.36
42	Aeoc	1191	38.71
42	Fagr	1886	61.30
43	Aeoc	36	0.88
43	Fagr	1762	42.91
43	Quru	2307	56.20
44	Aeoc	19	0.97
44	Fagr	1927	99.03

Table 42. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Spence Field to Little Bald

Plot No.	Species	Basal area	Relative dominance
45	Acsa	75	2.03
45	Aeoc	360	9.70
45	Fagr	3279	88.27
46	Aeoc	788	22.44
46	Fagr	2725	77.56
47	Aeoc	260	8.95
47	Belu	20	0.68
47	Fagr	2627	90.37
48	Belu	72	2.86
48	Coal	40	1.58
48	Fagr	2393	95.56

Table 43. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Derrick Knob

Plot No.	Species	Basal area	Relative dominance
49	Acsa	417	19.79
49	Aeoc	1562	74.07
49	Fagr	129	6.14
50	Acsa	44	1.06
50	Aeoc	2587	62.06
50	Fagr	1537	36.88
51	Acsa	535	26.03
51	Aeoc	632	30.79
51	Fagr	887	43.19
52	Fagr	3053	100.00
53	Acsa	99	4.56
53	Amla	79	3.65
53	Belu	5	0.24
53	Fagr	1984	91.55
54	Acpe	521	13.06
54	Acsa	40	0.99
54	Aeoc	292	7.32
54	Belu	476	11.93
54	Fagr	2659	66.69
55	Acsa	3292	52.48
55	Aeoc	1534	24.46
55	Belu	56	0.88
55	Fagr	1391	22.18
56	Acsa	410	7.13
56	Belu	4159	72.39
56	Fagr	1176	20.47

Table 44. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Silers Bald

Plot No.	Species	Basal area	Relative dominance
57	Fagr	4467	100.00
58	Fagr	3584	100.00
59	Acsp	44	1.02
59	Fagr	4255	98.98
60	Acsp	20	0.51
60	Aeoc	784	20.45
60	Fagr	3032	79.04
61	Aeoc	87	5.59
61	Fagr	1462	94.41
62	Aeoc	363	18.28
62	Fagr	1624	81.72
63	Acsa	27	0.64
63	Aeoc	1780	43.06
63	Fagr	2327	56.30

Table 45. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Newfound Gap

Plot No.	Species	Basal area	Relative dominance
64	Belu	2075	47.15
64	Fagr	1890	42.95
64	Piru	431	9.18
64	Vial	5	0.12
65	Belu	1966	66.99
65	Fagr	969	33.01
66	Fagr	2512	96.29
66	Piru	97	3.71
67	Acpe	424	6.23
67	Acsp	45	0.67
67	Aeoc	95	1.39
67	Belu	2132	31.28
67	Fagr	3888	57.05
67	Piru	14	0.20
67	Soam	216	3.18
68	Acpe	233	7.56
68	Acsp	138	4.47
68	Fagr	1749	56.72
68	Haca	58	1.88
68	Piru	906	29.38
69	Amla	394	10.76
69	Fagr	3264	89.09
69	Vial	6	0.16
70	Acsa	866	16.88
70	Fagr	1831	35.70
70	Haca	995	19.40
70	Piru	1437	28.02
71	Acsa	1425	21.35
71	Fagr	2902	43.46
71	Haca	2003	30.00
71	Piru	346	5.19
72	Fagr	3627	96.73
72	Piru	123	3.27
73	Aeoc	2487	42.46
73	Fagr	3369	57.54
74	Fagr	6197	100.00

Table 46. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Indian Gap

Plot No.	Species	Basal area	Relative dominance
75	Acsp	194	11.69
75	Fagr	1462	88.31
76	Fagr	1200	100.00
77	Abfr	124	4.23
77	Belu	814	27.69
77	Fagr	2003	68.08
78	Aeoc	1548	47.00
78	Fagr	1746	53.00
79	Aeoc	1238	36.47
79	Fagr	2128	62.70
79	Piru	28	0.83
80	Fagr	1388	98.32
80	Piru	24	1.68
81	Fagr	2143	76.23
81	Piru	668	23.77
82	Acsp	34	1.22
82	Belu	371	13.25
82	Fagr	1937	69.25
82	Piru	448	16.04
82	Vial	7	0.24
83	Aeoc	1392	34.39
83	Fagr	2656	65.61
84	Fagr	3889	100.00
85	Belu	82	2.17
85	Fagr	3685	97.83
86	Acsp	55	0.57
86	Belu	8742	90.36
86	Fagr	385	3.98
86	Piru	485	5.02
86	Vial	7	0.07

Table [illegible]. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech Forest plots - Cont.

Location: Indian Gap

Plot No.	Species	Basal area	Relative dominance
57	Acsp	311	[illegible]
57	Beal	158	[illegible]
57	Fagr	1608	[illegible]
58	Beal	[illegible]	[illegible]
58	Fagr	[illegible]	[illegible]

Table 47. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Mesa Knob

Plot No.	Species	Basal area	Relative dominance
89	Fagr	1811	59.27
89	Piru	1224	40.73
90	Abfr	57	0.97
90	Belu	1057	17.90
90	Fagr	1017	17.22
90	Piru	3578	60.59
90	Soam	196	3.32
91	Abfr	100	1.41
91	Belu	3837	54.10
91	Fagr	648	9.14
91	Piru	2507	35.35
92	Acsp	30	2.30
92	Fagr	1268	97.70
93	Fagr	1749	77.12
93	Prpe	519	22.88
94	Abfr	53	1.87
94	Fagr	2770	98.13
95	Fagr	3669	100.00
96	Acsp	189	8.03
96	Belu	1240	52.76
96	Soam	921	39.20
97	Abfr	42	3.19
97	Fagr	1269	96.81
98	Abfr	356	16.84
98	Acsp	97	4.59
98	Fagr	1663	78.57
99	Fagr	1085	87.57
99	Soam	154	12.43
100	Abfr	679	17.34
100	Belu	1195	30.51
100	Fagr	2042	52.15

Table 47. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots - Cont.

Location: Mesa Knob

Plot No.	Species	Basal area	Relative dominance
101	Belu	4728	92.87
101	Fagr	363	7.13
102	Fagr	2962	100.00
103	Abfr	13	0.93
103	Coal	67	4.93
103	Fagr	1274	94.14
104	Abfr	253	8.19
104	Belu	760	24.59
104	Fagr	1835	59.41
104	Piru	241	7.80
105	Abfr	1001	12.11
105	Belu	6165	74.60
105	Fagr	1098	13.29

Table 48. Basal area and relative dominance of woody species greater than 2.5 centimeters dbh found in Great Smoky Mountains Beech forest plots

Location: Pauls Gap and Beech Gap

Plot No.	Species	Basal area	Relative dominance
106	Acsa	1964	33.07
106	Aeoc	1886	31.76
106	Fagr	2087	35.16
107	Aeoc	17	0.77
107	Coal	10	0.45
107	Fagr	2132	98.78
108	Acsa	523	13.51
108	Aeoc	30	0.78
108	Belu	350	9.04
108	Fagr	2967	76.67
109	Fagr	3126	100.00
110	Acsa	20	2.36
110	Fagr	812	97.64
111	Acsa	201	7.29
111	Aeoc	1392	50.49
111	Fagr	60	2.18
111	Prpe	1104	40.05
112	Acpe	72	1.68
112	Aeoc	504	11.66
112	Belu	604	13.98
112	Fagr	3061	70.84
112	Quru	80	1.85
113	Aeoc	138	3.33
113	Belu	282	6.82
113	Fagr	3715	89.95
114	Aeoc	2224	43.95
114	Fagr	2836	56.05
115	Aeoc	1714	29.86
115	Fagr	4027	70.14

March 3, 1849

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environment and cultural value of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.